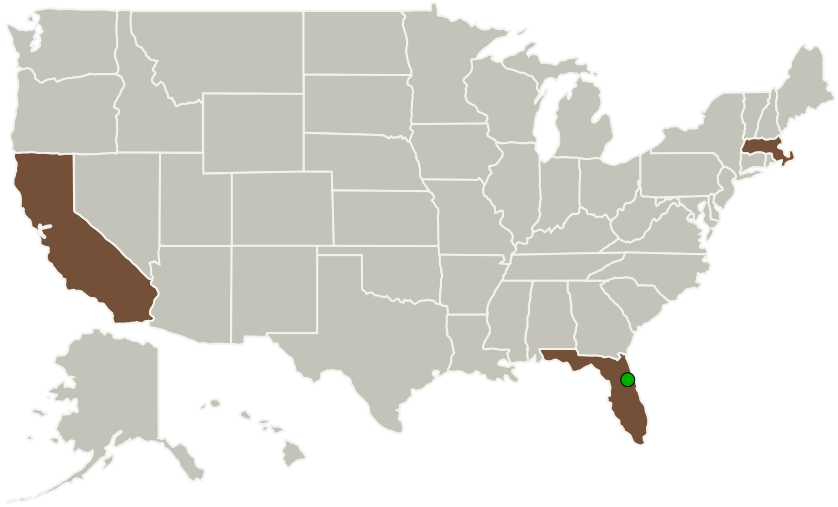
Terahertz Quantum Cascade Laser Based 3D Imaging, Phase I

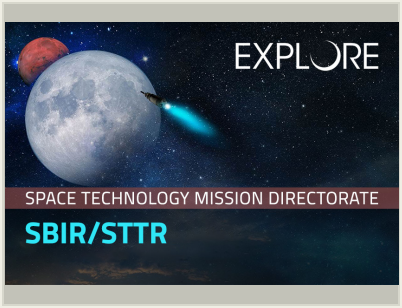
Completed Technology Project (2010 - 2011)

Project Introduction

The NASA Constellation program has a need to non-destructively test (NDT) non-metallic materials (foams, Shuttle Tile, Avcoat, etc) for defects such as delaminations and voids. While imaging systems at terahertz frequencies (0.3 to 3 THz) have been demonstrated for 2D imaging of similar materials, they have not yet demonstrate full 3D volumetric imaging. To meet this need, LongWave Photonics proposes to use high-power, low-frequency terahertz quantum cascade lasers (QCLs) developed at MIT, to demonstrate 3D imaging using Laser Triangulation. By using high-power QCL sources, large signal to noise ratios (SNRs) are attainable, resulting in resolution of subtle defects at fast scan speeds. The shorter wavelengths emitted by QCLs, 60 to 250 µm, allow high lateral and depth resolution. The feasibility of a second system based on Swept-Source Optical Coherence Tomography will also be explored using a recently developed tunable THz QCL from MIT. In addition to the benefits of high SNR, this technique allows sub-wavelength depth resolution. The current generation of QCLs are compatible with a cooling package that is <1 Kg, with <100 W power consumption. Phase II work will package a second generation of QCLs in a compact system to meet NASA's portable 3D NDT needs.

Primary U.S. Work Locations and Key Partners





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Organizations Performing Work	Role	Type	Location
LongWave Photonics, LLC	Lead Organization	Industry	Mountain View, California
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
Massachusetts Institute of Technology(MIT)	Supporting Organization	Academia	Cambridge, Massachusetts

Primary U.S. Work Locations	
California	Florida
Massachusetts	

Project Transitions

February 2010: Project Start

January 2011: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137592)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

LongWave Photonics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Alan W Lee

Co-Investigator:

Alan W Lee

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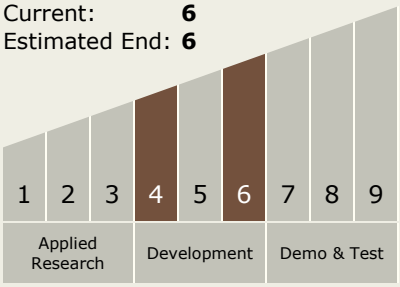
Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System